



DEFENSE INFORMATION SYSTEMS AGENCY

JOINT INTEROPERABILITY TEST COMMAND

FORT HUACHUCA, ARIZONA

**VALIDATION TEST PLAN
FOR
JOINT PHOTOGRAPHIC EXPERTS
GROUP INTERIM LOW BIT RATE
COMPRESSION ALGORITHM
FOR THE
NATIONAL IMAGERY TRANSMISSION
FORMAT STANDARD**



7 April 1997

**VALIDATION TEST PLAN
FOR
JOINT PHOTOGRAPHIC EXPERTS GROUP INTERIM LOW BIT RATE
COMPRESSION ALGORITHM
FOR THE
NATIONAL IMAGERY TRANSMISSION FORMAT STANDARD**

7 April 1997

Submitted by:

**Jack E. Brandt
Chief
Open Systems Division**

Approved by:

**STEVE E. BRIDGES
Department Head
C2 and Combat Support Systems Department
Joint Interoperability Test Command**

Prepared under the direction of:

**Mr. Stephen W. Kerr
Joint Interoperability Test Command
Fort Huachuca, Arizona 85613-7020**

EXECUTIVE SUMMARY

The National Imagery and Mapping Agency requested the Joint Interoperability Test Command (JITC) to conduct validation testing of the proposed Joint Photographic Experts Group (JPEG) Interim Low Bit Rate Compression Algorithm. This algorithm is being considered as an interim model for the National Imagery Transmission Format Standard (NITFS) suite of standards. The JPEG Interim Low Bit Rate Compression Algorithm provides compression capabilities beyond the standard JPEG Discrete Cosine Transform Compression algorithm.

Validating the JPEG Interim Low Bit Compression Algorithm requires the simultaneous consideration of all NITFS standards to ensure the resulting algorithm is free of conflicts, complete, unambiguous, results in products that are interoperable with other NITF users and is compliant with the NITFS.

The JITC NITF Certification Test and Evaluation (CTE) Facility will conduct the validation test in accordance with Chapter 2 of JIEO Circular 9008, NITFS CTE Program Plan, 30 June 93 and as outlined in this document. The results of the validation test effort will be used by the imagery standards community as critical information for establishing the overall standards validation process and for the addition of the proposed feature to the NITFS.

TABLE OF CONTENTS

PARAGRAPH		PAGE
SECTION I: INTRODUCTION		
I-1	BACKGROUND	1-1
	I-1.1 General	1-1
	I-1.2 JPEG Interim Low Bit Rate Compression Algorithm	1-1
	I-1.3 Validation Methodology	1-1
I-2	PURPOSE	1-2
I-3	SCOPE	1-3
	I-3.1 Overview	1-3
	I-3.2 Resources	1-4
	I-3.3 Test Schedule.	1-6
	I-3.4 Limitations	1-6
I-4	JPEG INTERIM LOW BIT RATE COMPRESSION ALGORITHM DESCRIPTION	1-6
SECTION II: DETAILS OF TEST		
II-1	SUBTEST I, STATIC REVIEW	2-1
	II-1.1 Objective	2-1
	II-1.2 Criteria	2-1
	II-1.3 Test Procedures	2-1
	II-1.4 Results	2-2
	II-1.5 Analysis and Discussion	2-2
II-2	SUBTEST II, DYNAMIC REVIEW	2-4
	II-2.1 Objective	2-4
	II-2.2 Criteria	2-4
	II-2.3 Test Procedures	2-4
	II-2.4 Results	2-5
	II-2.5 Analysis and Discussion	2-6

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

FIGURE	TITLE	PAGE
1	Candidate Conformance Test	1-2
2	General Validation Approach	1-4
3	CTE Facility Configuration	1-5
4	Example of Subtest 1 Results	2-3
5	Example of Test Incident Report	2-5

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
A	ACRONYMS	A-1
B	REFERENCES	B-1
C	EVALUATION APPROACH	C-1
D	CANDIDATE TEST SCENARIOS	D-1

SECTION I: INTRODUCTION

I-1 BACKGROUND

I-1.1 General. The Joint Interoperability Test Command (JITC) was requested by the National Imagery and Mapping Agency (NIMA) to conduct validation testing of the proposed Joint Photographic Experts Group (JPEG) Interim Low Bit Rate Compression Algorithm for the NITFS. This algorithm is being considered as an interim model for the National Imagery Transmission Format Standard (NITFS) suite of standards. The NITFS is a series of standards for formatting digital imagery related products and exchanging them among members of the Intelligence Community (as defined by Executive Order 12333), the Department of Defense, and other departments or agencies of the United States Government, as governed by Memoranda of Agreement (MOA).

I-1.2 JPEG Interim Low Bit Rate Compression Algorithm. The NITFS community is looking into a compression algorithm that would reduce the transmission time beyond the JPEG Quality Level 1. This is not possible with the current JPEG Discrete Cosine Transform (DCT) algorithm, therefore, an "Interim" compression algorithm was proposed addition to the standard until a long-term solution can be implemented. The JPEG Interim Low Bit Rate Compression Algorithm is an approach whose purpose is to increase compression rate, thus reducing transmission time between users. The JPEG Interim Low Bit Rate Compression Algorithm provides compression capabilities beyond standard JPEG. This interim solution will reduce storage and transmission time of images between two or more computer systems by reducing the amount of data that is needed to represent the original image.

I-1.3 Validation Methodology. The NITFS validation methodology is based on a five step process as outlined in JIEO Circular 9008. Upon successful completion of these steps, the technical aspects of proposed additions to the standards are considered validated. A natural outcome of this process is the creation of the Means of Testing (MOT) for conformance testing of products which also includes the new features of the standard.

a. Step 1. First the service, functional, and performance requirements are fully identified and the appropriate authority ratifies that they are valid. Next, the test objectives and criteria are developed, which will be used to verify whether the proposed solution satisfies the validated requirements. As the appropriate authority, the Imagery Standards Management Committee (ISMC)/NITFS Technical Board (NTB) ratifies the requirements and establishes the validation objectives and criteria.

b. Step 2. As the proposed addition to the standard is drafted, candidate conformance test objectives, criteria, and test cases are also developed. The candidate conformance test objectives for the proposed JPEG Interim Low Bit Rate Compression Algorithm are identified in Appendix C of this plan.

c. Step 3. A physical realization of the addition to the standard is implemented. The proponent for the "Interim" standard will sponsor the development of software implementation and sample NITF files. JITC will develop test procedures and software test tools needed to conduct conformance testing independent of the developer, but in coordination with the development of the nominated JPEG Interim Low Bit Rate Compression Algorithm.

d. **Step 4.** The candidate conformance test procedures and tools will be used to verify that the sample implementation and files conform to the proposed standard. Figure 1 provides an overview of the Candidate Conformance Test. Based on conformance test results, the sample implementation and files may be modified and retested until they adequately conform to the proposed standard. The candidate test procedures, test scenarios, cases and tools are also subject to revision based on the analysis of test results.

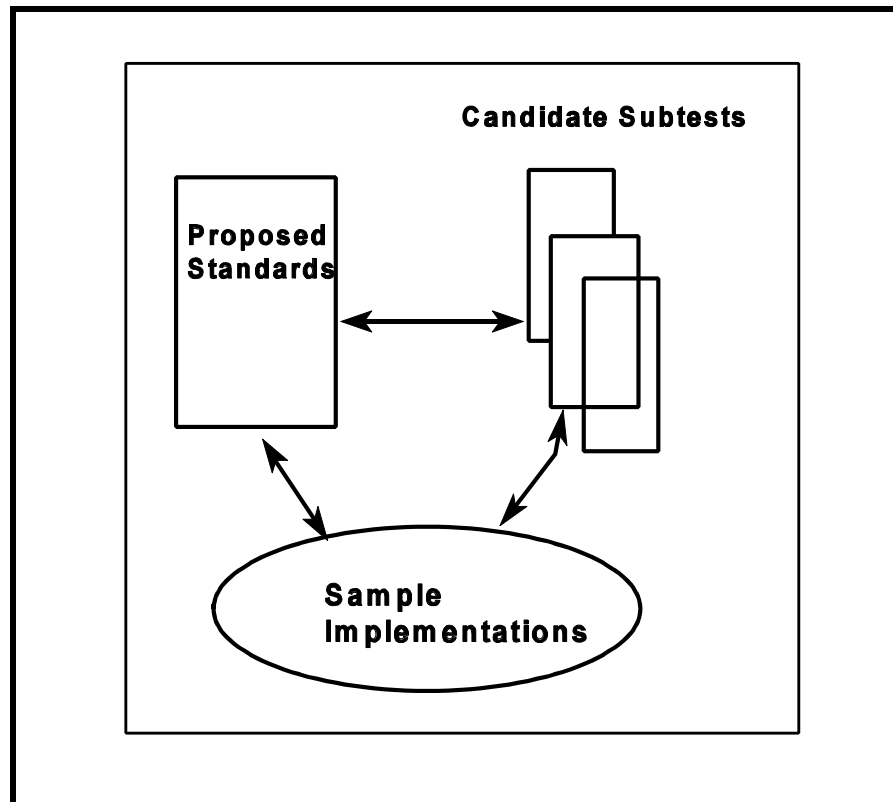


Figure 1. Candidate Conformance Test

e. **Step 5.** Once the sample implementation is verified as conforming to the proposed standard, the implementation is evaluated against the objectives and criteria defined in the first step to measure how well the proposed standard meets the original service, functional, and performance requirements. During this phase, pair-wise comparisons are made of multiple implementations of the standard, providing assurance that all standard compliant implementations are interoperable. This step will not be accomplished within the scope of this plan, but is a follow-on action to be taken under the direction of the ISMC/NTB.

I-2 PURPOSE. This validation test plan outlines the process, methodology, and test related actions that will be taken to help validate the proposed JPEG Interim Low Bit Rate Compression Algorithm. Proposed additions to the NITFS are validated to ensure that the standards are technically correct, consistent, complete, and testable. The technical objective of the effort is to validate that the proposed text of the standard, the sample implementation of the standard, and the candidate conformance testing are in harmony.

I-3 SCOPE

I-3.1 Overview. Figure 2 portrays the general approach JITC will use to validate the proposed JPEG Interim Low Bit Rate Compression Algorithm.

a. Static Review

(1) **Analyze Standards.** The first phase of the NITFS validation process will include a review and an analysis of the entire suite of NITF standards and the proposed additions to the standards to identify any internal conflicts, oversights, or ambiguities which are considered faults and must be resolved before the proposed additions can be verified.

(2) **Identify Specified Requirements.** A complete set of requirements will be extracted from the proposed standard and broken down into those that state policy and those considered to be implementation issues. Both types of requirements are important for the overall analysis of the standard (the implementation issues are of particular use in nominating the test criteria and strategies).

(3) **Nominate Test Criteria and Strategies.** Test strategies, criteria and methods by which the interfaces can be tested for conformance to each implementation requirement will be identified and nominated.

b. Dynamic Review. The second NITFS validation process is to develop candidate test cases and execute the test strategy on sample files and implementations of the proposed standard. To be useful in DOD procurements, conformance to mandated requirements (particularly those with operational consequences) must be testable. There are several steps involved in determining the testability of mandated requirements. The procedure is outlined in the following subsections.

(1) **Develop Candidate Conformance Test Cases.** Based on the identified implementation requirements, candidate conformance test cases will be developed for evaluation of the sample implementation.

(2) **Execute Conformance Test.** Based on the capabilities provided by the developer, test cases will be executed and results collected.

(3) **Identify Testability Shortfalls.** All shortfalls on the overall testability of the proposed standard will be identified.

(4) **Determine Testability of Criteria.** The conformance test results and testability shortfalls will be reviewed for overall impact on testability of the proposed standard. All facets of the effort (proposed text, sample implementation, and candidate test cases) are considered suspect during analysis.

(5) **Report Findings.** All problems and shortfalls identified in the dynamic review process will be reported for inclusion in the overall static and dynamic results of the process.

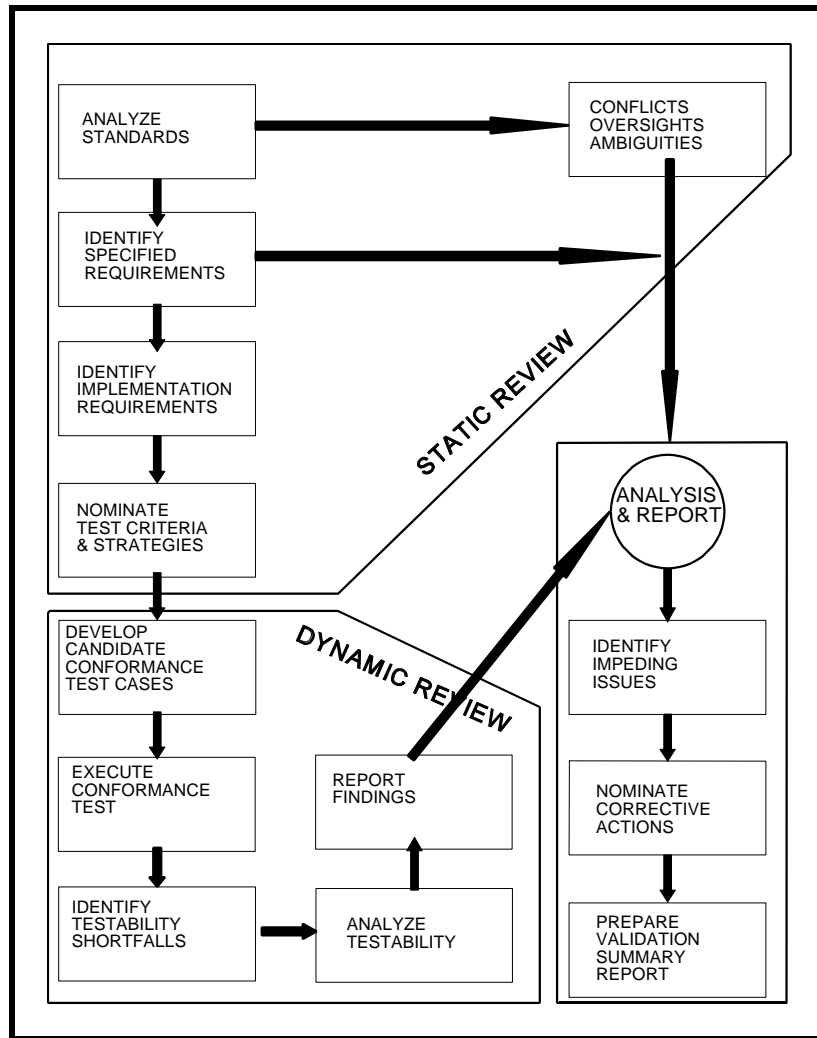


Figure 2. General Validation Approach

c. Analysis & Report

(1) Identify Impeding Issues. The static and dynamic reviews result in a set of issues which will be documented and analyzed for corrective action.

(2) Nominate Corrective Actions. Proposed corrective actions for each identified issue will be nominated to the preparing agency. Recommendations will be made to either change the proposed text of the standard, change the sample implementation, or change the candidate test cases. The objective is to get the proposed standard, sample implementation, and the candidate test cases in harmony. Resolutions to the issues will be again passed through the static and dynamic review cycles.

(3) Prepare Validation Summary Report. All analysis and associated efforts will be documented in a report.

I-3.2 Resources. The NITFS Certification Test and Evaluation (CTE) Facility is configured to support testing of digital imagery systems. Figure 3 provides an overview of the CTE Facility's configuration. The developer will provide a sample software implementation and sample NITF files that will be loaded on the CTE Facility's digital imagery systems. The NITFS CTE Facility test personnel have previously validated the imagery Compression algorithms for Joint Photographic Experts Group (JPEG), Bi-Level, and Adaptive Recursive Interpolated Differential Pulse Code Modulation (ARIDPCM). The CTE Facility has conducted numerous tests for imagery military standards over the past five years. They are uniquely qualified to perform this validation assessment of the proposed JPEG Interim Low Bit Rate Compression Algorithm for inclusion in the NITF format.

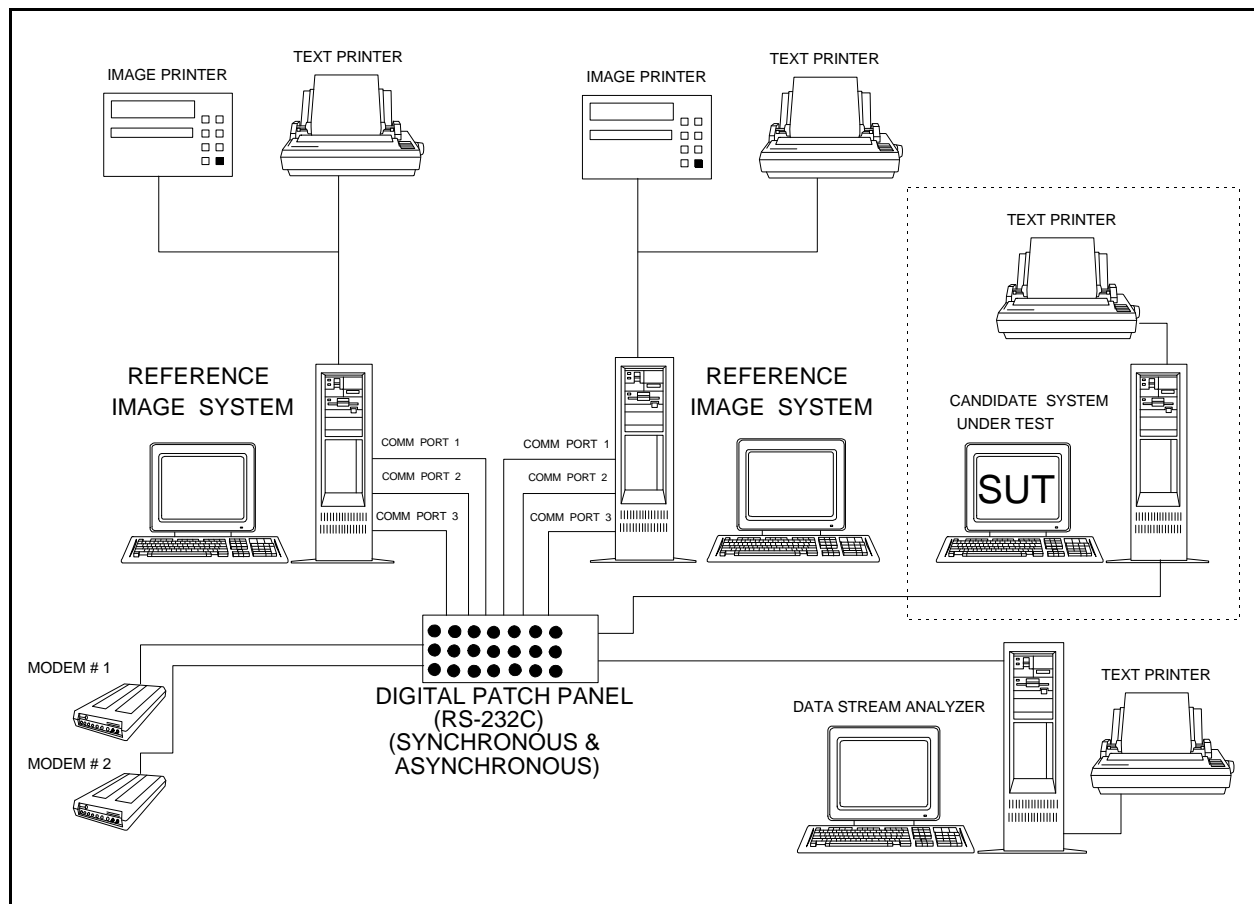


Figure 3. CTE Facility Configuration

I-3.3 Test Schedule. The static portion of the validation began February 1997 as part of the process required to prepare this validation test plan. The initial round for conducting the dynamic review will begin once sample NITF files and an implementation are made available to JITC. Results will be reported at a scheduled NTB meeting. Regression testing will be scheduled on an as-needed basis pending the disposition of the NTB.

I-3.4 Limitations. Standards cannot be guaranteed to be free of conflicts, unambiguous, and/or complete. The static review by itself provides a limited level of confidence that the addition to the standard meets these requirements. The implementation review:

- Provides an analysis of a sample implementation built in accordance with the text of the proposed standard;
- Determines the extent to which the proposed standard is implementable;
- Determines the extent to which the proposed standard is testable;
- Confirms or reflects identified shortfalls and findings from the static review effort.

The static review coupled with the dynamic review provides a more thorough analysis of the proposed standard and a higher level of confidence in the validation of the standard than if only the traditional text review was conducted.

I-4 JPEG Interim Low Bit Rate Compression Algorithm Description. The Interim Low Bit Rate Compression Algorithm is an interim algorithm for the National Imagery Transmission Format Standard (NITFS) suite of standards. The JPEG Interim Low Bit Rate Compression Algorithm is an approach to increase compression rates, with minor impact on quality, thus reducing transmission time between users. The motivation for this algorithm was that users in the NITF community were limited in transmission bandwidth. The "Interim" JPEG is considered a temporary solution; the long term resolution to these issues will be implemented using the ISO JPEG 2000 Compression algorithm once completed. The Interim Low Bit Rate Compression is performed in two stages: downsampling and upsampling. The execution of the downsampling process entails the passing of pixel values through a downsampling filter and then applying JPEG lossy DCT compression to the downsampled values. The sampling occurs in two dimensions; rows and columns. The downsampling filters includes an ideal reconstruction filter for digital-to-analog (D/A) conversion and an ideal anti-aliasing filter. The anti-aliasing filter is included in the downsampling process since a resampling of the signal is required before the JPEG Compression is performed. Upsampling is very similar to the downsampling process, but in this case the image is sampled more frequently. The increased sampling frequency is required to match the dimensions of the upsampled image to the original image. The upsampling process requires only an analog-to-digital (A/D) filter since no resampling occurs.

DETAILS OF TEST

II-1 SUBTEST 1, STATIC REVIEW

II-1.1 Objective. Determine to what extent the proposed JPEG Interim Low Bit Rate Compression Algorithm is technically correct, consistent, complete, and can be incorporated within the overall NITF format.

II-1.2 Criteria. In the context of standards validation, the term "validation" means to determine whether a standard is capable of supporting its intended use and is adequately documented to support implementation by different developers. From its intended use, a number of key criteria can be derived which the standard must be able to support:

a. Free of Conflicts. The proposed addition to MIL-STD-2500 and the complete suite of NITF standards must be mutually free of conflicts (e.g. technical or logical conflicts of requirements) that if implemented, will not cause the implementation to violate applicable conformance standards and contain a clear set of precedence statements by which any conflicts can be resolved.

b. Completeness. The standard must specify, or support specification of, all parameters within the scope of the standard that are necessary to support the development of a new implementation. In addition to the static review, the reference example (dynamic review) is evaluated to see if the text addresses all demonstrated features.

c. Ambiguity. The standard must specify required capabilities in an unambiguous way so that there is no confusion as to what is required.

d. Conformance Testability. It must be feasible to test that products or implementations conform to the standard.

II-1.3 Test Procedures

a. Test Conduct

(1) **Analyze Proposed Addition to the Military Standard.** JITC NITFS CTE Facility personnel will analyze the proposed text of the addition to the MIL-STD-2500 and its associated standards in accordance with the general validation approach discussed in Section I. Each sentence, clause, and equation will be evaluated for accuracy and absence of conflict through an exhaustive comparison of all affected standards. Additionally, the proposed standard will be distributed to NTB members and to all interested entities as listed in the DOD's Standards Directory 1 (SD-1) for review. All comments resulting from the static review cycle will be accumulated for analysis. Observations from the dynamic review (e.g. Does the implementation match the text and the desired function of nomination?) having impact on the proposed text will also be evaluated. This will be the primary source for assessing accuracy of content, completeness, lack of ambiguity, and testability of the proposed text.

(2) **Flag Issues.** Any issues uncovered will be flagged to the Center for Standards (CFS) and the proponent prior to detailed analysis.

b. Data Collection. Data to be collected will include any anomalies or issues identified during the Static Review and Dynamic Review along with associated comments and recommended resolutions.

II-1.4 Results. The results of the Static Review will be documented as individual issues.

a. Criteria Related. Figure 4 provides an example of how Subtest 1 results will be recorded. Major anticipated categories of issues include:

- (1) Conflicts/inaccuracies.
- (2) Missing information.
- (3) Clarifications.
- (4) Testability.
- (5) Ambiguity.
- (6) Minimize impact of implementation.
- (7) Administrative issues. Errors in grammar, spelling, punctuation etc.

b. Other. None.

II-1.5 Analysis and Discussion. Each issue resulting from the document review will be described and will include an impact statement and suggested resolution. This may be an iterative process in conjunction with NTB member review.

a. Analyze Issues. Each issue raised will be analyzed to determine its validity and identify a possible solution. There are three possible outcomes of this analysis:

(1) Issue Cleared. The issue may not have been valid, in which case the issue will be flagged as a cleared issue.

(2) Solution Available. A solution may be apparent or the results of further analysis and testing may have developed a solution. In either case, recommended solutions to issues will be provided as they are discovered.

(3) Validation Problem. An issue may be determined to be a problem sufficiently disruptive that may require major re-work of the standard. In such an event, the problem will be flagged to the CFS along with a recommendation against validation of the standard in its current form.

b. Evaluate Test Results. The results of the test will be evaluated to determine whether all aspects of the issue have been covered. The results of the testing will be included into the overall issue analysis process. It can be anticipated that the issue will be resolved as: (1) Issue cleared, (2) validated problem, or (3) a solution is available and a recommendation is made.

MIL-STD-XXXX VALIDATION ISSUE

1. **ISSUE TITLE:** Typographical and Grammatical
2. **ISSUE NUMBER:** 1
3. **VERSION NUMBER:** 1
4. **CATEGORY:** Administrative
5. **DATE:** 25 January 199X
6. **ACTION ORGANIZATION:** JIEO Center for Standards
7. **POINTS OF CONTACT:** Name of Individual Making Comment, Organization Office Symbol, phone number.
8. **STATUS:** OPEN
9. **DISCUSSION:** The following items are errors in grammar, typos, or titles:
 - a. Para 3.1.a. NITF is National Imagery Transmission Format Standard vice "Standards".
Rationale: National Imagery Transmission Format Standard is the proper name.
 - b. Para 3.1.b. Data Elements. Figure X should be referenced here.
Rationale: This paragraph is where the standard begins discussion on the items contained in figure x.
10. **CONCLUSION:** The above items have simple solutions and can be easily resolved.
11. **RECOMMENDATION:** Recommended changes are contained in the discussion.
12. **RESOLUTION:** Forthcoming.

Figure 4. Example of Subtest 1 Results

c. **Summary Report.** The Summary Report will describe the degree to which the standard can be considered validated, areas that have validation shortfalls, and recommendations for corrective action. Exceptions to the validation are expected to be categorized as follows:

(1) **Issues with Recommendations.** Issues with recommendations that would clear the issues once accepted by the standards working group committee.

(2) **Issues that are Unresolvable.** These are issues for which there appears to be no resolution other than major change to one or more standards.

(3) **Pending Test Issues.** Some issues may require further testing to determine whether they can be resolved. For example, a feature specified in the standard may not have been included in the sample implementation that was made available to the test team. Testing may extend beyond the currently identified date for reporting on validation. These issues will be stated, along with the consequences and recommendation on how to proceed pending test completion.

II-2 SUBTEST II, DYNAMIC REVIEW

II-2.1 Objectives. The objectives of the dynamic review are:

- a. To develop and verify the nominated test strategy using a sample implementation of the proposed specification.
- b. To evaluate the degree of compliance of the sample implementation to the proposed specification.
- c. To enhance the documentation review of Subtest 1 through the technical experience gained through the process of attempting to implement the specification and measure its compliance.

II-2.2 Criteria

- a. Test cases can be constructed which fully measure the nominated compliance criteria for the standard.
- b. The sample implementation has implemented all features defined in the standard.
- c. The sample implementation does not contain needed features that are not fully defined in the standard. For each functional requirement in the standard, there is consistency between the text of the standard, the realization of the functional requirement in the sample implementation, and the means of testing.
- d. A suitable means of measure can be identified and accomplished for each requirement of the standard. There is a process in place to present test results, analyze the results, and present conclusions and recommendations.

II-2.3 Test Procedures

a. Test Conduct. The test team will develop candidate subtests needed to evaluate the nominated compliance criteria. The initial candidate subtests are described in Appendix C. A summary of candidate test cases is shown in a tabular form in Appendix D. The table indicates which subtest criteria are exercised by each candidate test case. The test team will execute the Candidate Subtests according to the nominated procedures, scenarios and test cases.

- b. Data Collection.** Data Collection requirements are as follows:
- (1) Annotated data collection forms with any scenario related anomalies noted.
 - (2) Hard copies of the comparison between the scenario results and the control data.

a. **Criterion Related.** The resulting test data will be correlated to the above criteria by means of a pass/fail/not implemented matrix. Identified problems will be described in a Test Incident Report (TIR) with attached hard copy of the image(s) or test tool printout(s). Figure 5 is an example of a test incident report. Any failures will be explained in sufficient detail to ensure a full understanding of specific problems related to this subtest.

b. **Other.** None

II-2.5 Analysis and Discussion. The test team will examine the test data to determine to what extent the sample implementation is compliant with the proposed JPEG Interim Low Bit Rate Compression Algorithm. As an implementation anomaly is discovered, it will be documented. The anomaly will be analyzed against the applicable criteria and an assessment on the overall impact will be included. Criteria used for validation testing, candidate test cases/scenarios, and text in the specification are suspect and subject to change. The testers will work with the developer to reach a recommended resolution. The resulting recommendations will be widely disseminated for comments and review to ensure that the interested community is mutually satisfied. The resulting criteria and test cases will become the measures by which future implementations will be evaluated for conformance to the new standard.

APPENDIX A

ACRONYMS

<u>ACRONYM</u>	<u>DEFINITION</u>
CFS	Center for Standards
CTE	Certification Test and Evaluation
DCT	Discrete Cosine Transform
DISA	Defense Information Systems Agency
DOD	Department of Defense
ISMC	Imagery Standards Management Committee
JIEO	Joint Interoperability and Engineering Organization
JITC	Joint Interoperability Test Command
JPEG	Joint Photographic Experts Group
LUT	Look Up Tables
MIL-HDBK	Military Handbook
MIL-STD	Military Standard
MOA	Memoranda of Agreement
MOT	Means of Testing
NIMA	National Imagery and Mapping Agency
NITF	National Imagery Transmission Format
NITFS	National Imagery Transmission Format Standard
NTB	NITFS Technical Board
RFC	Request For Change
RST	Restart
SUT	System Under Test
TIR	Test Incident Report
UDID	User Defined Image Data

APPENDIX B REFERENCES

The following list of references will be used in the evaluation of the proposed addition to the MIL-STD-2500.

B-1 Planning References

- JIEO Circular 9008, National Imagery Transmission Format Standard (NITFS) Certification Test & Evaluation Program Plan, 30 June 1993.
- NITFS Certification Test Plan, 3 January 1994.
- BWC Working Group Notes of NITF Interim Low Bit Rate Compression Algorithm, 15 January 1997.
- Detailed Implementation Guidelines for the Interim Low Bit Rate Compression Algorithm, 27 November 1996.
- Kickoff Meeting Minutes for NITF Interim Low Bit Rate Compression Algorithm, 3 October 1996.

B-2 Technical References

- MIL-HDBK-1300A. National Imagery Transmission Format Standard (NITFS) Handbook, 30 June 1993.
- MIL-STD-2500A. National Imagery Transmission Format Version 2.0, 12 October 1994.
- MIL-STD-188-198A. Joint Photographic Experts Group (JPEG) for NITFS, 12 October 1994.
- MIL-STD-2045-44500. Tactical Communications Protocol 2 (TACO2), 30 June 1993 and Notice, 29 July 1994.
- MIL-STD-2301. Computer Graphics Metafile (CGM) for NITFS, 30 June 1993 and Notice 1, 12 October 1994.
- MIL-STD-188-196. Bi-Level Image Compression, 30 June 1993.

APPENDIX C

CANDIDATE EVALUATION APPROACH AND MEANS OF TESTING

C-1 Objective. To determine to what extent the SUT can properly downsample and upsample image(s) that are compliant with the NITFS standard.

C-2 Criteria. The SUT can downsample and upsample images and overlays using the JPEG Interim Low Bit Rate Compression Algorithm. Test scenarios should reflect the image sizes that are prevalent in current libraries (emphasis should be put on images that are approximately 1408x1408).

a. Compression

- (1) SUT supports the sync based mode for downsampling.
- (2) Image Compression field of the image subheader is set to I1 when the image has been compressed using JPEG Interim Low Bit Rate Compression Algorithm.
- (3) The SUT supports various source sample precision for all CLEVELs. But should specifically follow the CLEVEL range specification set by JPEG.
- (4) Downsampling supports anti-aliasing sampling.
- (5) Downsampling has a sampling ratio that is greater than one.
- (6) Downsampling is performed twice, once for each respective dimension; rows and columns.
- (7) Mirrors the edge of original image before downsampling.

b. De-Compression

- (1) The SUT supports the sync based mode for decompression.
- (2) Bit depth remain the same throughout process (downsampling-JPEG Compression-upsampling).
- (3) When error(s) in the decompression process occurs in the data stream, the SUT must replace the encoded/decoded image file corrupted data with a pattern so that when the image is displayed it is apparent that the compressed image data had an error. This pattern shall be limited to the RST interval(s) in which the error occurred. All RST intervals without errors must be decoded and displayed.
- (4) Upsampling has a sampling ratio that is less than one.
- (5) Upsampling is performed twice, once for each respective dimension; rows and column.

(6) Frequency of the original signal matches the frequency of the upsampled signal.

c. File Compliance. Compliant files will adhere to the following criteria:

(1) Subsampling of image w/ overlay(s), CGM and Bit-Map, should have no impact on receiver. Overlays should follow the guidelines set forth by respective MIL-STD.

(2) Pixel locations will be the same before downsampling and after upsampling (Visually it may appear that there has been some movement due to the JPEG compression/de-compression algorithm's use of neighborhoods).

(3) SUT should support 8 Bit monochrome images without LUT.

(4) SUT should support downsampling/upsampling of both even and uneven image sizes.

(5) SUT should support blocked images.

(6) SUT supports Geocentric/Geodetic and UTM coordinate systems for images.

C-3 Test Procedures

a. Test Conduct. The SUT will be provided a series of predefined uncompressed images imbedded in NITF files that the SUT will be required to compress. The images from the Compression process will be visually and electronically compared to the control images/files. Detailed Interim LBR Compression test cases are identified in APPENDIX D, Table D-1A.

b. Data Collection. Data collection requirements for both the Compression and decompression tests are as follows:

(1) Compression

(a) Annotated data collection forms with any JPEG Interim Low Bit Rate Compression Algorithm related anomalies noted.

(b) Hard copies of control JPEG "Interim" uncompressed image(s).

(c) Hard copy results of the comparison between the SUT's encoder quantization values and the reference encoder quantization values (if available).

(2) De-Compression

(a) Annotated data collection forms with any JPEG "Interim" related anomalies noted.

(b) Hard and soft copies of the JPEG "Interim" uncompressed control image(s).

(c) If anomalies exist, then hard and soft copies will be made of JPEG "Interim" uncompressed image(s)/NITF file(s) as displayed and generated by reference imagery system(s).

(d) Hard copies of the comparison between the SUT's decoder quantization values and the reference decoder quantization values (if available).

(e) Hard copies of control JPEG "Interim" uncompressed image test scenarios.

C-4 Results

a. Criterion Related. The resulting test data will be correlated to the above criteria by means of a pass/fail/not yet implemented matrix. Identified problems will be described in a Test Incident Report (TIR) with attached hard copy of the image(s) or test tool printout(s). Any failures will be explained in sufficient detail to ensure a full understanding of specific problems related to this subtest.

C-5 Analysis and Discussion. The test team will examine all test data to verify that the SUT correctly interprets and generates JPEG "Interim" compressed images according to the above criteria. A determination will be made if the JPEG "Interim" compression/decompression was executed within tolerance. Where anomalies exist, a determination will be made of the impact on NITF certification. The test team will examine the test data to determine to what extent the sample implementation is compliant with the proposed addition to the MIL-STD-2500A and JIEO Circular 9008. As an implementation anomaly is discovered, it will be documented. The anomaly will be analyzed against the applicable criteria and an assessment on the overall impact will be included. Criteria used for validation testing, candidate test cases/scenarios, and text in the standard are suspect and subject to change. The testers will work with the developer to reach a recommended resolution. The resulting recommendations will be widely disseminated for comments and review to ensure that the interested community is mutually satisfied. The resulting criteria and test cases will become the measures by which future implementations will be judged for conformance to the new standard.

APPENDIX D
CANDIDATE TEST SCENARIO

Table D-1A
SUBTEST JPEG "INTERIM" (downsampling)

Downsampling/Test Case	J C 0 1	J C 0 2	J C 0 3	J C 0 4	J C 0 5	J C 0 6	J C 0 7	J C 0 8	J C 0 9	J C 1 0	J C 1 1	J C 1 2	J C 1 3	J C 1 4	J C 1 5	J C 1 6	J C 1 7	J C 1 8	J C 1 9
a. Bits per Pixel																			
1. Eight bits per pixel all CLEVELs																			
b. Anti-Aliasing Sampling																			
1. Downsampling includes an anti-aliasing filter																			
c. Interchange Format																			
1. Image subheader is set to I1 (or IX)																			
d. Sync Sampling																			
1. Downsampling is performed using the Sync function																			
e. Mirroring																			
1. Downsampling uses mirroring for edges of downsampled edges																			
f. Sampling																			
1. Sampling ratio is greater than one																			
2. Sampling is performed in two steps, once for each respective dimension; rows and column																			

Table D-1B
SUBTEST JPEG "INTERIM" (upsampling)

UPSAMPLING \ TEST CASE	J C 2 0	J C 2 1	J C 2 2	J C 2 3	J C 2 4	J C 2 5	J C 2 6	J C 2 7	J C 2 8	J C 2 9	J C 3 0	J C 3 1	J C 3 2	J C 3 3	J C 3 4	J C 3 5	J C 3 6	J C 3 7	J C 3 8	J C 3 9	J C 4 0
a. Bits per Pixel																					
1. Eight bits per pixel all CLEVELS . . .																					
b. Bit Depth																					
1. The Bit depth remain the same throughout JPEG Interim Low Bit Rate Compression process (Downsampling-JPEG-Upsampling)																					
c. Sync Sampling																					
1. Downsampling is performed using the Sync function																					
d. Sampling																					
1. Sampling ratio is greater than one																					
2. Sampling is performed in two steps, once for each respective dimension: rows and column																					
e. Error Detection																					
1. The SUT must replace the encoded image file corrupted data with a pattern to inform user(s) that file contains error(s)																					
f. Frequency																					
1. The SUT must replace the decoded image file corrupted data with a pattern to inform user(s) that file contains error(s)																					

Table D-1C
SUBTEST JPEG "INTERIM" (File Compliancy)

FILE COMPLIANCY/TEST CASE	J C 4 1	J C 4 2	J C 4 3	J C 4 4	J C 4 5	J C 4 6	J C 4 7	J C 4 8	J C 4 9	J C 5 0	J C 5 1	J C 5 2	J C 5 3	J C 5 4	J C 5 5	J C 5 6	J C 5 7	J C 5 8	J C 5 9
a. Overlays																			
1. Subsampling of image w/ overlay should have no impact on receiver																			
b. Pixels																			
1. Pixels at the upsampled end should not change location from the original image																			
c. Monochrome Images																			
1. Support 8 Bit Images																			
d. Sizes																			
1. Support Images of even and uneven size																			
e. Coordinates																			
1. Support UTM Images																			
2. Support Geocentric/Geodetic Images																			
f. Blocked																			
1. Support Images that are blocked																			